On the Earliest Provable Traces of good Practical Astronomy. By C. Piazzi Smyth, Astronomer Royal for Scotland.

(*Abstract by the Author.*)

The author,—taking up the method of examining by modern mensuration, the exactness of the contemporary astronomical orientation of ancient buildings,—passes in review the oldest structures of Ethiopia, Egypt, Chaldæa, Assyria, Media, Babylon, Persia, Greece, Etruria, India, Cambodia, and America, in so far as they can claim to be really antique, and to have been well measured recently. He then arranges them into three classes, viz.:—

1st. Those which have no definite astronomical position;

2nd. Those which are oriented, as to the sides of their bases, *diagonally* to the cardinal points; and

3rd. Those which are directed *on* these points.

The 2nd and 3rd classes include all the most ancient buildings examined; and while the diagonal method prevailed generally in Mesopotamia, and culminated in its most splendid example in the temple of Nebo devoted to all the Planets at Babylon,—the direct form characterized the Pyramids of Lower Egypt, of which the Great Pyramid is the typical specimen.

Comparing, then, Sir H. Rawlinson's measures of the orientation of the sides of the Nebo building, with his own made upon those of the Great Pyramid (and which are fully given in an appendix), the author deduces the remarkable result,—that the Pyramid building was oriented by its architect no less than sixty times more accurately than the Babylonian; and yet the Pyramid was earlier by full 1500 years!

Some comparisons then follow on the respective Pyramid and Babylonian systems of metrology, and their influences on ourselves even at the present time.

Note on the Coefficient of Expansion of the Brass Pendula used in the Indian Trigonometrical Survey. By Major J. F. Tennant, R.E.

I had intended to lay before the Meeting an abstract of the proceedings of the Indian Trigonometrical Survey, which Col. Walker the Superintendent asked me to make from his Report, but have been prevented from doing so.

One result has however been announced, so important that I have obtained permission to lay it before you in a less formal way before the Session closes.

Many of you are probably aware that Col. Walker took to India certain brass pendula, the property of the Royal Society,

and a vacuum apparatus for swinging these pendula at a very low pressure of atmosphere. Capt. Basevi (of our corps) was duly instructed in the use of this apparatus, and after a good deal of trouble, got it to work satisfactorily in India. Observations had been taken at several stations, and provisionally reduced, of which the results were lately published in the Proceedings of the Royal Society. But in the Report of which I am now speaking, Col. Walker states that in these reductions there is an anomaly, which at present points to the probability that at a pressure of only 5 inches of mercury the coefficient of expansion of the brass pendulum must be not only increased, but appears to be 13 per cent greater than ever before has been assigned to brass.

I do not suppose any one here anticipated such a result, though we know that in extreme cases the law of expansion varies. The boiling points of fluids depend on the pressure, and so does the melting point of some bodies. Near these critical points the regular progress of expansion changes, and as it is highly improbable that the change commences suddenly, it seems not improbable that the law of uniform progress of expansion with temperature is only an approximation to a far more general law, in which the dimension of every body depends (as we know that of a gas does), but by a complicated relation, on the pressure and temperature, and that by removing $\frac{5}{6}$ths of the pressure, the terms dependent on it may become sensible.

We have been in the habit of considering that the linear dimension is of the form $l + l.\ t.\ \frac{d\,l_0}{d\,t_0} + \frac{1}{2}\,l.t^2.\ \frac{d^2\,l_0}{d\,t_0^2}$ at the utmost. Col. Walker's result, if confirmed, would tend to add a term $l.\ \mathrm{F}\,(t)\ \frac{d^2\,l_0}{d\,t_0\,d\,p_0}$ but if there be such a term, there is a probability that there are coefficients of $\frac{d\,l_0}{d\,p_0}$ and $\frac{d^2\,l_0}{d\,p_0^2}$ which might be sensible to a sufficiently refined investigation, and that the coefficient of $\frac{d^2\,l_0}{d\,t_0\,d\,p_0}$ does not only contain l and t. This is tantamount to a variation of the size of a solid with pressures alone, which has (so far as I know) never been contemplated as recognisable. At the same time, one can hardly conceive that change of pressure shall give the particles of a body so much freedom of motion that the temperature coefficient shall change, without causing a change of size at the same time.

There have, I understand, been some anomalies at Kew, which Mr. Balfour Stewart has not traced to temperature; but it is quite certain, that in the observing season in India, the diurnal range of temperature is far greater than at Kew, and that the effect of a change in the temperature coefficient would be much more marked. Col. Walker will doubtless do what he can with the means at his disposal, but pendula

seem unadapted for investigating this question; and I would hope that some worthy successor of Baily and Sheepshanks, will with special means undertake to investigate a question which is absolutely necessary to complete the theory of pendula and standards of length and capacity.

Recent Observations and Remarks of Hofrath Schwabe regarding Sun-spots and other Solar Phenomena.

Communicated by W. De la Rue, B. Stewart, and B. Loewy.

About two months ago Hofrath Schwabe called our attention to certain phenomena on the surface of the Sun, which he had noticed since last December and which he recollected to have occurred before, but only at the time of a minimum in the number of Sun-spots. The phenomena are :—1st. *A total absence of faculæ or faculous matter.* 2nd. *Absence of the usually observed scars, pores, and similar appearances.* 3rd. *An equal brightness of the whole surface, the limb being as luminous as the centre.*

Hofrath Schwabe desired us to go over his observations, which are at present at Kew Observatory, to extract similar facts formerly noticed, and to inform him whether some of these phenomena had also been observed in this country.

The observations were carefully scanned; and it was noticed that the phenomena occur only in years of minimum spot-frequency. The extracts, which we append, and which might have been multiplied, are quite sufficient to show the regularity of their recurrence, and also that the year 1833 was particularly characterized by the frequency of observations of them.

We also applied to the Rev. F. Howlett, whose well-known exquisite delineations of Sun-spots and faculæ gave us the best promise of learning something more relating to delicate changes on the surface of the Sun; but unfortunately Mr. Howlett's impaired health has obliged him to withdraw almost wholly from his usual application to Sun observations during the period in question. He however states in his answer, that "he had certainly noticed how uniformly bright the Sun's surface has been of late, in connection with an almost total absence of faculæ."

We think it right to state (without expressing our own opinion in the matter) that Hofrath Schwabe thinks he has noticed a connexion between Sun-spots and meteoric showers. He says in his last letter, "The minimum of spot-frequency coincides remarkably with the recurrence of meteoric showers, the period of rotation of which, viz., 33·2 years, agrees with a larger period of the sun-spots. In 1833 there was an extreme scarcity of spots (only 33 very small groups being observed),